We claim:

1. A process for producing one or more of a β-hydroxy-ketone product or an α,β-unsaturated ketone product, the process comprising reacting an aldehyde reactant with a ketone reactant, the ketone reactant having at least one hydrogen atom alpha to the carbonyl, in a reaction mixture comprising the aldehyde reactant, the ketone reactant, and a catalyst comprised of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reacting is carried out at a reaction time of no more than 120 minutes.

2. The process according to claim 1, wherein no more than 4 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

3. The process according to claim 1, wherein no more than 3 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

4. The process according to claim 1, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 20 wt.%.

5. The process according to claim 1, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

6. The process according to claim 1, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 50 wt.%.

7. The process according to claim 1, wherein the reaction time is no more than 60 minutes.

8. The process according to claim 1, wherein the reaction time is no more than 30 minutes.

9. The process according to claim 1, wherein the reaction time is no more than 20 minutes.

10. The process according to claim 1, wherein the reaction time is no more than 10 minutes.

11. The process according to claim 1, wherein the reacting is carried out in the substantial absence of a solubilizing agent.

12. The process according to claim 1, wherein the molar ratio of ketone reactant to aldehyde reactant is from 1:1 to 20:1.

13. The process according to claim 1, wherein the molar ratio of ketone reactant to aldehyde reactant is from 1:1 to 14:1.

14. The process according to claim 1, wherein from 1.05 to 10 moles of ketone reactant are used per mole of aldehyde.

15. The process according to claim 1, wherein the molar ratio of the hydroxide or alkoxide of the alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.001:1 to 0.45:1.

16. The process according to claim 1, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.45:1.

17. The process according to claim 1, wherein the molar ratio of the hydroxide or alkoxide of the alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.001:1 to 0.25:1.

18. The process according to claim 1, wherein the molar ratio of the hydroxide or alkoxide of the alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

19. The process according to claim 1, wherein the molar ratio of the hydroxide or alkoxide of the alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.10:1.

20. The process according to claim 1, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide, potassium hydroxide, cesium hydroxide, lithium

hydroxide, magnesium hydroxide, calcium hydroxide, barium hydroxide, sodium methoxide, sodium ethoxide, sodium propoxide, sodium butoxide, potassium methoxide, potassium ethoxide, potassium propoxide, potassium butoxide, cesium methoxide, cesium ethoxide, cesium propoxide, cesium butoxide, lithium methoxide, lithium ethoxide, lithium propoxide, lithium butoxide, magnesium methoxide, magnesium ethoxide, magnesium propoxide, magnesium butoxide, calcium methoxide, calcium ethoxide, calcium propoxide, calcium butoxide, barium methoxide, barium ethoxide, barium propoxide, or barium butoxide.

21. The process according to claim 1, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

22. The process according to claim 1, wherein the reacting is carried out at a temperature from 25°C to 175°C.

23. The process according to claim 1, wherein the reacting is carried out at a temperature from 40°C to 165°C.

24. The process according to claim 1, wherein the catalyst is provided as an oxide of an alkali metal or an alkaline earth metal which forms in the reaction mixture a hydroxide.

25. The process according to claim 1, wherein the reacting is carried out batchwise.

26. The process according to claim 1, wherein the reacting is carried out in a continuous plug flow reactor.

27. The process according to claim 1, wherein the reacting is carried out in a series of two or more continuous stirred tank reactors.

28. The process according to claim 1, wherein the aldehyde reactant comprises one or more of: acetaldehyde; propionaldehyde; n-butyraldehyde; 2-methyl-propanal; n-pentanal; 2-methyl-butanal; 3-methyl-butanal; 2,2-dimethyl-propanal; n-hexanal; 2-ethyl-butanal; 2,2-dimethylbutanal; 2,3-dimethylbutanal; 2-methyl-pentanal; 3-methylpentanal; 4-methyl-pentanal; n-heptanal; 2-methylhexanal; 2-ethylpentanal; 2,2-dimethylpentanal; 2,3-dimethylpentanal; 2,4-dimethylpentanal; 2-ethyl-3-methylbutanal; 2-ethyl-2-methylbutanal; n-octanal; 2-ethylhexanal; n-nonanal; n-decanal; n-undecanal; n-dodecanal; benzaldehyde; 4-chlorobenzaldehyde; 3-chlorobenzaldehyde; 2-chlorobenzaldehyde; phenyl acetaldehyde; o-tolualdehyde; m-tolualdehyde; p-tolualdehyde; p-methoxybenzaldehyde; o-ethoxybenzaldehyde; m-methoxybenzaldehyde; cyclopropane carboxaldehyde; cyclobutane carboxaldehyde; cyclopentane carboxaldehyde; cyclohexane carboxaldehyde; 2-methylcyclohexane carboxaldehyde; 3-methylhexane carboxaldehyde; or 4-methylhexane carboxaldehyde.

29. The process according to claim 1, wherein the ketone reactant comprises one or more of: acetone, 2-butanone, 2-pentanone, 3-methyl-2-butanone, 2-hexanone, 4-methyl-2-pentanone, pinacolone, 2-heptanone, 5-methyl-2-hexanone, 2-octanone, 2-nonanone, 2-decanone, 2-undecanone, 2-dodecanone, cyclobutanone, cyclopentanone, cyclohexanone, cyclooctanone, 3,3-5-trimethylcyclohexanone, tricyclo[5.2.1.02,6]decan-8-one, or acetophenone.

30. The process according to claim 1, wherein the reacting is carried out at a temperature from 50°C to 160° C.

31. The process according to claim 1, wherein the reacting is carried out at a pressure from about 1 to about 70 atmospheres.

32. The process according to claim 1, wherein the reacting is carried out at a pressure from about 1 to about 45 atmospheres.

33. The process according to claim 1, wherein a portion of the water of reaction created during the reaction is removed during the course of the reaction.

34. The process according to claim 33, wherein the portion of the water of reaction removed is no more than 80% of the theoretical amount of water generated.

35. The process according to claim 1, wherein the reacting is carried out in one or more of: a tubular reactor operated adiabatically, a staged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

36. The process according to claim 35, wherein the reaction time is no more than 10 minutes.

37. The process according to claim 35, wherein the reaction time is no more than 2 minutes.

38. A process for producing one or more of: 7-ethyl-2-methylundec-5-en-4-one or 6-hydroxy-7ethyl-2methyl-undecan-4-one, the process comprising reacting 2-ethylhexanal with 4-methylpentan-2-one in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

39. The process according to claim 38, wherein no more than 3 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

40. The process according to claim 38, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

41. The process according to claim 38, wherein from 1.05 to 10 moles of ketone reactant are used per mole of aldehyde.

42. The process according to claim 38, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

43. The process according to claim 38, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

44. The process according to claim 38, wherein the reacting is carried out batchwise.

45. The process according to claim 38, wherein a portion of the water of reaction created during the reaction is removed during the course of the reacting.

46. The process according to claim 38, wherein the portion of the water of reaction removed is no more than 80% of the theoretical amount of water generated.

47. The process according to claim 38, wherein the reacting is carried out in one or more of: a tubular reactor operated adiabatically, astaged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

48. The process according to claim 47, wherein the reaction time is no more than 10 minutes.

49. A process for producing one or more of: 4-hydroxy-2-heptanone or 3-hepten-2-one, the process comprising reacting n-butyraldehyde with acetone in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

50. The process according to claim 49, wherein no more than 4 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

51. The process according to claim 49, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, and wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

52. The process according to claim 49, wherein from 1.05 to 14 moles of ketone reactant are used per mole of aldehyde.

53. The process according to claim 49, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

54. The process according to claim 49, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

55. The process according to claim 49, wherein the reacting is carried out batchwise.

56. The process according to claim 49, wherein the reacting is carried out in a series of two or more continuous stirred tank reactors.

57. The process according to claim 49, wherein the reacting is carried out in one or more of: a tubular reactor operated adiabatically; a staged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

58. The process according to claim 57, wherein the reaction time is no more than 10 minutes.

59. A process for producing one or more of: 4-hydroxy-5-methyl 2-hexanone or 5-methyl-3-hexen-2-one, the process comprising reacting 3-methyl-propanal with acetone in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

60. The process according to claim 59, wherein no more than 4 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

61. The process according to claim 59, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

62. The process according to claim 59, wherein from 1.05 to 14 moles of ketone reactant are used per mole of aldehyde.

63. The process according to claim 59, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

64. The process according to claim 59, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

65. The process according to claim 59, wherein the reacting is carried out batchwise.

66. The process according to claim 59, wherein the reacting is carried out in a series of two or more continuous stirred tank reactors.

67. The process according to claim 59, wherein the reacting is carried out in one or more of: a tubular reactor operated adiabatically; a staged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

68. The process according to claim 67, wherein the reaction time is no more than 10 minutes.

69. A process for producing one or more of: 3-hydroxy-2-pentanone or 3-penten-2-one, the process comprising reacting acetaldehyde with acetone in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

70. The process according to claim 69, wherein no more than 3 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

71. The process according to claim 69, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

72. The process according to claim 69, wherein from 1.05 to 14 moles of ketone reactant are used per mole of aldehyde.

73. The process according to claim 69, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

74. The process according to claim 69, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

75. The process according to claim 69, wherein the reaction is carried out batchwise.

76. The process according to claim 69, wherein the reaction is carried out in a series of two or more continuous stirred tank reactors.

77. The process according to claim 69, wherein the reaction is carried out in one or more of: a tubular reactor operated adiabatically; a staged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

78. The process according to claim 77, wherein the reaction time is no more than 10 minutes.

79. A process for producing one or more of: 6-methyl-3-hepten-2-one or 6-methyl-3-hydroxy-2-heptanone, the process comprising reacting acetone with 3-methyl-butanal in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

80. The process according to claim 79, wherein no more than 4 wt.% water is present in the reaction mixture, with respect to the total weight of the reaction mixture.

81. The process according to claim 79, wherein the catalyst is provided as a solution of a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in the solution at a concentration of at least 25 wt.%.

82. The process according to claim 79, wherein from 1.05 to 14 moles of ketone reactant are used per mole of aldehyde.

83. The process according to claim 79, wherein the molar ratio of the hydroxide or alkoxide of an alkali metal or alkaline earth metal catalyst to the aldehyde reactant is from 0.005:1 to 0.15:1.

84. The process according to claim 79, wherein the hydroxide or alkoxide of the alkali metal or alkaline earth metal comprises one or more of: sodium hydroxide or potassium hydroxide.

85. The process according to claim 79, wherein the reaction is carried out batchwise.

86. The process according to claim 79, wherein the reaction is carried out in a series of two or more continuous stirred tank reactors.

87. The process according to claim 79, wherein the reaction is carried out in one or more of: a tubular reactor operated adiabatically; a staged tubular reactor with interstage heat exchange; a staged tubular reactor with interstage cold-shotting of reactant; an annular temperature-controlled jacketed tubular reactor; or a shell-and-tube heat exchanger.

88. The process according to claim 87, wherein the reaction time is no more than 10 minutes.

89. A process for producing one or more of: 4-hydroxy-undecan-6-one or 4-undecen-6-one, the process comprising reacting n-butanal with 2-heptanone in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

90. A process for producing one or more of: 2,8-dimethyl-3-hydroxy-nonan-5-one or 2,8-dimethyl-3-nonen-5-one, the process comprising reacting 2-methyl-propanal with 5-methyl-hexan-2-one in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

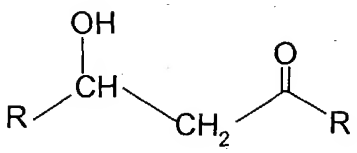
wherein the reaction is carried out at a reaction time of no more than 120 minutes.

91. A process for producing one or more of: 5-ethyl-4-hydroxy-nonan-2-one or 5-ethyl-3-nonen-2-one, the process comprising reacting 2-ethylhexanal with acetone in the presence of a catalyst comprising a hydroxide or alkoxide of an alkali metal or an alkaline earth metal, wherein the hydroxide or alkoxide is provided in a solution having a concentration of at least 15 wt.%, or as a solid,

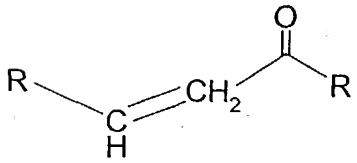
wherein no more than 6 wt.% water, based on the total of the water provided and water generated by reaction, is present in the reaction mixture, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out at a reaction time of no more than 120 minutes.

92. A process for preparing one or more of a compound of the formulas:

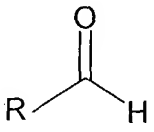


or

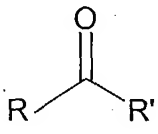


,

wherein each R is independently a hydrocarbyl group;
which process comprises contacting in a reaction mixture a compound of the formula

(i) 

with a compound of the formula

(ii) 

,

wherein each R is independently a hydrocarbyl group and R' is a hydrocarbyl group having at least one hydrogen atom on the carbon atom which serves as the point of attachment,

in the presence of

(iii) a catalyst comprised of a hydroxide or C_1-C_8 alkoxide of an alkali metal or alkaline earth metal, wherein the hydroxide or C_1-C_8 alkoxide of an alkali metal or alkaline earth metal is provided by at least one of:

(a) in a solution having a concentration of at least 15 weight percent, or

(b) as a solid,

wherein no more than 6 weight percent water, based on the total weight of the water provided in the reaction mixture or the combination of water provided and water generated *in situ* is present in the reaction mixture upon completion, with respect to the total weight of the reaction mixture, and

wherein the reaction is carried out within a period of no more than 120 minutes.